

***Radar Investigation of Asteroids and Planetary Satellites***

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***Strategy***

Radar reconnaissance of near-Earth asteroids, mainbelt asteroids, the Galilean satellites, the Martian satellites, and large Saturnian satellites, using the Arecibo 13-cm and the Goldstone 3.5-cm systems. Measurements of echo strength, polarization, and delay/Doppler distribution of echo power provide information about dimensions, spin vector, large-scale topography, cm-to-m-scale morphology, and surface bulk density. The observations also yield refined estimates of target orbital elements.

***Progress and Accomplishments***

Radar signatures have been measured for 35 mainbelt asteroids and 27 near-Earth asteroids since this task began ten years ago. Observations of the near-Earth asteroid 1989 PB, conducted shortly after its optical discovery, yield a sequence of delay-doppler images that reveal it to consist of two distinct lobes that appear to be in contact, or nearly so. 1989 PB may have formed as a result of collisional disruption of a much larger object in the main asteroid belt, when two fragments that had been dispersed by that collision at low relative velocity became gravitationally bound to each other. Echoes from the near-Earth object 1986 DA show it to be significantly more reflective than other radar-detected asteroids. This result supports the hypothesis that 1986 DA is a piece of NiFe metal derived from the interior of a much larger object that melted, differentiated, cooled, and subsequently was disrupted in a catastrophic collision. This 2-km asteroid, which appears smooth at cm-to-m scales but extremely irregular at 10-to-100-m scales, might be (or have been a part of) the parent body of some iron meteorites. Phobos' 3.5- and 13-cm echoes reveal surface characteristics very different from those of most near-Earth asteroids, but similar to those of the largest C-class asteroids. The radar signatures of Europa, Ganymede, and Callisto have recently been measured at 3.5, 13, and 70 cm and are extremely unusual at all three wavelengths.

***Projected Accomplishments***

1) Publication of all delay-doppler asteroid radar astrometry obtained during 1980-1990, along with refined orbital estimates and disc-integrated radar properties for all astrometrically observed targets. 2) Delay-doppler resolution of echoes from 324 Bamberga and 3103 (1982 BB). 3) Measurement of the 3.5-cm signature of a large S-class object (7 Iris).

## ***Publications***

- Ostro, S. J., and E. M. Schoemaker (1990). The extraordinary radar echoes from Europa, Ganymede, and Callisto: A geological perspective. *Icarus* **85**, 335-345 (1990).
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- Ostro, S. J., J. F. Chandler, A. A. Hine, I. I. Shapiro, K. D. Rosema, D. K. Yeomans (1990). Radar Images of Asteroid 1989 PB. *Science* **248**, 1523-1528.